Tri-Dimensional Engineering, Inc.
ENGINEERING • PLANNING • SURVEYING

Hydrology Study

Village Walk Townhomes

Residential Subdivision

TM 5535

Environmental Log No. 07-09-005

Pala Street
Ramona, California 92065

Prepared for:

LB Village Investments, LLC
and
County of San Diego

REGISTERED PROFESSIONAL ENGINEER
ERNEST H. GRABBE JR.
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CIVIL
STATE OF CALIFORNIA

2-23-2010

Prepared by:

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January 20, 2010
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SUMMARY: The 1.31 acre, undeveloped lot in Ramona will be developed into 14 single family detached condominium units. The site currently has two points of storm water discharge. All of the onsite water and a portion of the water from the street rights-of-way and adjacent lots drain to the northwest flowing through a culvert passing under Robertson Street. The post-development flows will be limited to the pre-development flow of 3.58 CFS at this point.

A portion of the storm water from the street rights-of-way and adjacent properties drain to the easterly into a curb inlet on La Brea Street. The post-development flows will be 1.24 CFS at this point compared to the 1.24 CFS pre-development flows. There will be no change the the flows from this drainage area outfalling into the existing downstream storm drainage system (CG-3464).

The on-site flows are routed through a series of bio-swales to pre-filter the storm water; then delivered by an underground drainage system to a lined, rock-filled filtration/retention trench. The filtration/retention trench will provide final filtration of the storm water and maintain the storm water flow at pre-development levels.

The outfall from the filtration/retention trench will be restricted to pre-development flows for the 2 year, 10 year and 100 year frequency storms of 1.64, 2.46, and 3.58 CFS respectively.

CURRENT CONDITIONS: The subject site, a 1.31 acre undeveloped lot in Ramona, is located approximately 600 feet south/southeast of Santa Maria Creek. It is bounded by two unpaved streets, Robertson Street to the norhtwest and Pala Street to the southwest. The site is bounded on the southeast by the partially paved La Brea Street. A residential home is located on the lot northeast of the site and one on the lot southwest of the site and Pala Street. The site is vegetated with non-native grass.

The site currently drains to the north northwest to a culvert crossing under Robertson Street then by overland flow to Santa Maria Creek. A portion of the lot to the northeast of the site and the lot southwest of Pala Street also drain into this culvert. These areas are designated Z-1 and Z-2 on the pre-development drainage Map, DM-A. The pre-development flow at the culvert is 3.58 CFS.

A portion of the northwesterly half of La Brea Street and a portion of the lot southwest of Pala Street drains into a curb inlet on La Brea Street at the easterly corner of the site. The area is designated Y-1 on the pre-development drainage Map, DM-A. The pre-development flow at this curb inlet were calculated to be 1.21 CFS. The pre-development flows for this catch basin were shown as 1.24 CFS on the street improvement plans (CG-3464) for a local shopping center. The storm runoff routed to this curb inlet then drains easterly into a County owned and maintained storm drainage system within the local shopping center. The final outfall is an open channel

west of La Brea Street, before it discharges into the Santa Maria Creek. The post-development increase in flow of 0.09 CFS will have neglible effect on the existing storm drainage system.

PROPOSED CONDITIONS: The project proposes to develop this 1.31-acre site into 14 detached single-family homes with incidental hardscape. At each home site, the storm water from the roof is directed into a landscaped bio-swale for pre-filtration. The minimum length of run in the bio-swale will be fifteen (15) feet. The storm water will then drain into an underground collection system and routed to a filtration/retention swale along the northeasterly side of the site.

The three streets bordering the project will be improved. On the southeast, La Brea Street will be improved to a twenty (20) foot half-width on the property side. The other side of La Brea Street has previously been improved to a twenty-six (26) foot half-width. The previously unpaved streets, Pala Street on the southwest and Robertson Street on the northwest, will be improved to a total width of twenty-eight (28) feet. Of this 28 feet portion, twenty (20) feet will be located on the project side, and eight (8) feet on the other side of the street centerline.

The improved streets will have concrete curbs and gutters. Curb openings will be placed periodically to route the storm water runoff into bio-swale trenches located behind the curbs. The storm runoff will be filtered in these bio-swales and routed to the underground storm drainage system via catch basins and/or curb inlets.

SCOPE AND PURPOSE: The objective of this Study is to determine the pre-development and the post-development runoff flows, and compare the values to determine adequacy of the proposed surface drainage features. The proposed drainage features have been designed to safely convey runoff to the existing natural watercourse in the event of a 100-year storm. The analysis includes the sizing and effect of the installation of water treatment facilities and infiltration/retention facilities. Water *quality* will be addressed in the project's Storm Water Management Plan.

CALCULATION METHODS: The Rational Method was used to determine total flow quantity at time of concentration for the 2 year, 10 year and 100-year-storm for each critical area. Where noted, the following equation was used to calculate time of concentration:

$$Tc = Ti + Tt;$$

T*i* was determined using the formula $T_i = \frac{1.8(1.1-C)\sqrt{D}}{\sqrt[3]{S}}$ from the County of San Deigo Hydrology Manual or from Table 3.3 of the San Diego County Hydrology Manual;

T*t* was calculated using travel times from overland, gutter and pipe flows, as appropriate, see Table 2, Appendix A.

The following equation was used to calculate rainfall intensity:

$i = 7.44(P_6)(D)^{-0.645}$ where P6 is the adjusted 6 hour rainfall and D is the duration (Total time of concentration.

The following equation was used to approximate coefficient of runoff, C, for drainage areas with multiple coefficients:

$C = [(C_{Area\ 1})(A_{Area\ 1}) + (C_{Area2})(A_{Area2}) + \ldots] / [A_{Area1} + A_{Area2} + \ldots]$

The storm water runoff for each drainage area was calculated using the following formula:

$Q(cfs) = A(acres) * C * i$

When drainage areas were combined or added together, a new *C* was calculated for the combined drainage areas.

For gutter, channel, pipe and other flows:

The manning equation, as follows, was used to determine flow quantities and sections of flow:

$Q = A * V$, where:

$V = (1.49/n) * r^{2/3} * s^{1/2}$

Where needed, the Bernoulli equation (along with Q=AV above) was used to determine flow characteristics:

$p_1/\gamma + Z_1 + V^2/2g = p_2/\gamma + Z_2 + V^2/2g + h_L$

Where:

Tc = Time of concentration (minutes)

T*i* = Travel time (minutes)

P_6 = Mean annual 6-hour runoff depth (in)

Q = Volume flow (ft^3/second)

L = Length of watercourse (ft)

i = Rainfall intensity (in/hour)

D = storm duration (minutes)

A = Cross-sectional area of flow (ft^2)

V = Cross-sectional mean velocity (ft/sec) n = Manning coeff. of roughness

r = Hydraulic radius (ft) s = Slope (ft/ft)

Inlet capacities were determined using the formulas for "Grated Inlets in Sag" from the San Diego County Drainage Design Manual, Chapter 2. The capacity of each grate operating as a weir, using the weir equation, and operating as an orifice, using the orifice equation, was determined. The more conservative of the two results was used.

Weir Equation:

$$Q = C_w * P_e * d^{3/2}$$

Orifice Equation:

$$Q = C_o * A_e * (2gd)^{1/2}$$

Where:

Q = inlet capacity of the grated inlet (CFS);

C_w = weir coefficient (C_w = 3 for US Traditional Units);

P_e = effective grate perimeter length (ft);

d = flow depth approaching inlet (ft)

C_o = orifice coefficient (C_o = 0.67 for US Traditional Units);

A_e = effective (clogged) grate area; and

g = gravitional acceleration (ft/s2).

FLOW AREAS AND CRITICAL SECTIONS:

Runoff flow quantities and conditions were analyzed at various drain inlets, channel (bio-swale) cross-sections, and all pipes included in the system. The conceptual grading plan indicates the location of drain inlets, pipe routing, channel (bio-swale) routing and the filtration/retention trenches. The Pre-Development and Post-Development Hydrolgy data sheets are found in Appendix A.

The infiltration/ retention trench sizing is also tabulized in the data sheets found in Appendix A.

Post-Development hydraulic calculations for the inlets, bio-swales (channels) and pipes are summarized in the data sheets found in Appendix C. The design of the storm drain system occurred concurrently with the preparation of this study.

Table 1 – Outfall Y, Area = 0.49 Acres

Storm Event	Pre-Development Flow	Post-Development Flow without Detention	Post-Development Flow with Detention (No Detention Provided)
100-year	1.24 cfs*	1.24 cfs	N/A
10-year	0.83 cfs	0.85 cfs	N/A
2-year	0.55 cfs	0.57 cfs	N/A

*Note: The pre-development flow as shown on CG-3464 is 1.24 cfs; our calculation indicate 1.21 cfs.

Table 2 – Outfall Z, Area = 2.76 Acres

Storm Event	Pre-Development Flow	Post-Development Flow without Detention	Post-Development Flow with Detention
100-year	3.58 cfs	6.02 cfs	3.57 cfs
10-year	2.46cfs	4.13 cfs	1.99 cfs
2-year	1.21 cfs	2.75 cfs	1.19 cfs

CONCLUSIONS:

1. This study indicates that if the project is constructed per plan, the proposed storm drain system at the subject site will be adequate to handle 100-year-storm conditions. As with all drainage facilities, regular maintenance on each component will prolong the life and function of the entire system.

2. The filtration/retention trenches to be constructed will limit any additional flow resulting from construction of proposed impervious areas such as roofs, driveways and incidental hardscape. In addition to maintaining current stormwater flow quantities and velocity discharges from the site, the filtration/retention trenches will also allow increase water quality via filtration. The project's SWMP shall address post-construction water *quality* issues.

3. The addition of the filtration/retention trenches will ensure that post-construction flow rates (Q) and velocities (V) will be less than or equivalent to pre-construction stormwater discharge levels.

4. Where possible, natural flow patterns have been maintained.

5. Modifications to the proposed system will require re-evaluation of the hydraulics by this office.

6. This is a preliminary study. A final hydrology study will be conducted when a final grading plan is created.

DECLARATION OF RESPONSIBLE CHARGE:

I hereby declare that I am the Civil Engineer of work for this project, that I have exercised responsible charge over the design of the project as defined in section 6703 of the Business and Professions Code, and that the design is consistent with current standards.

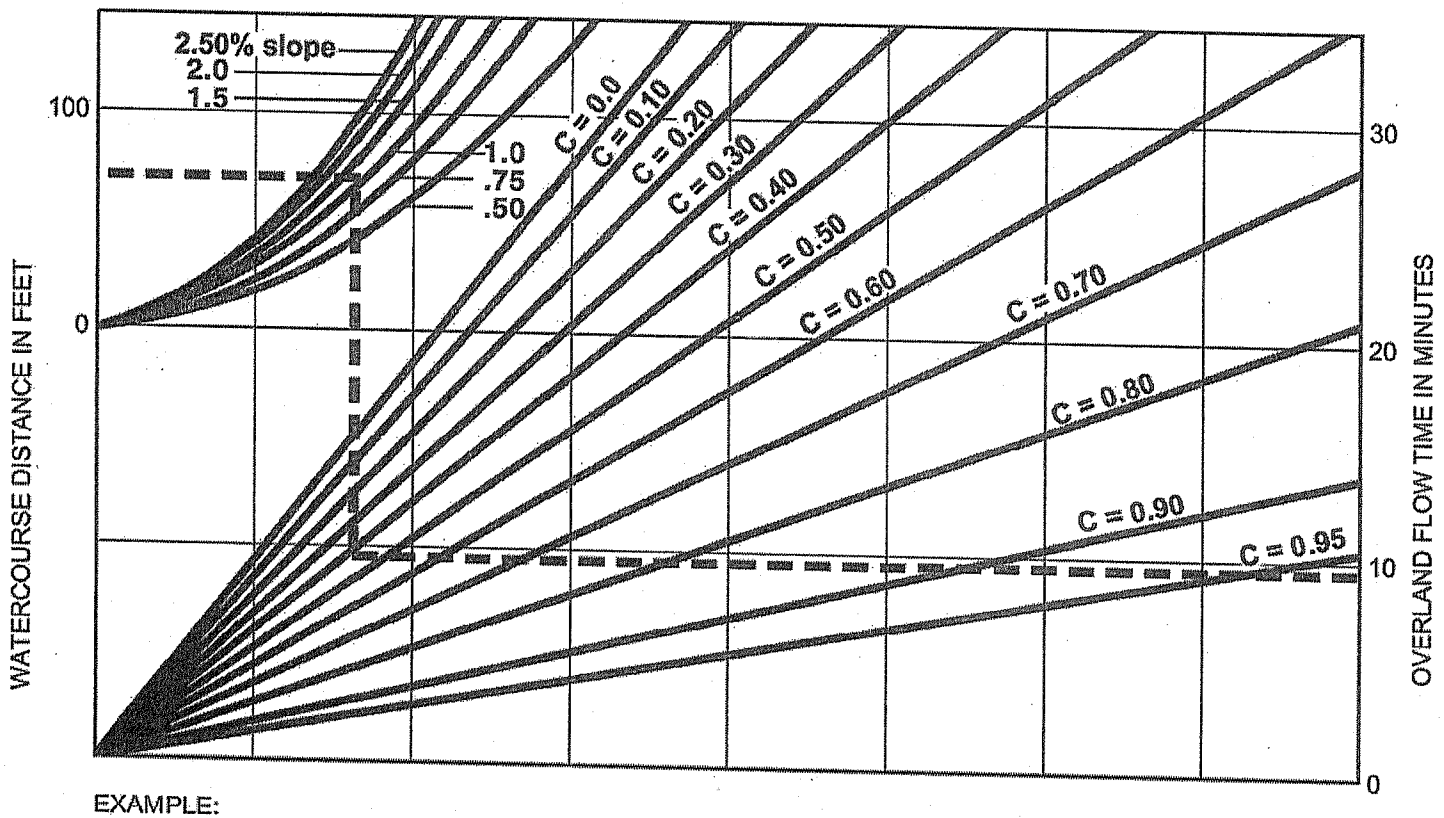
I understand that the check of the project drawings and specifications by the County of San Diego is confined to a review only and does not relieve me, as engineer of work, of my responsibilities for project design.

2-24-10

Ernest H. Grabbe, Jr. Date
RCE 047327
Expires 12-31-2011

Appendix A

Flow Characteristics Charts



EXAMPLE:

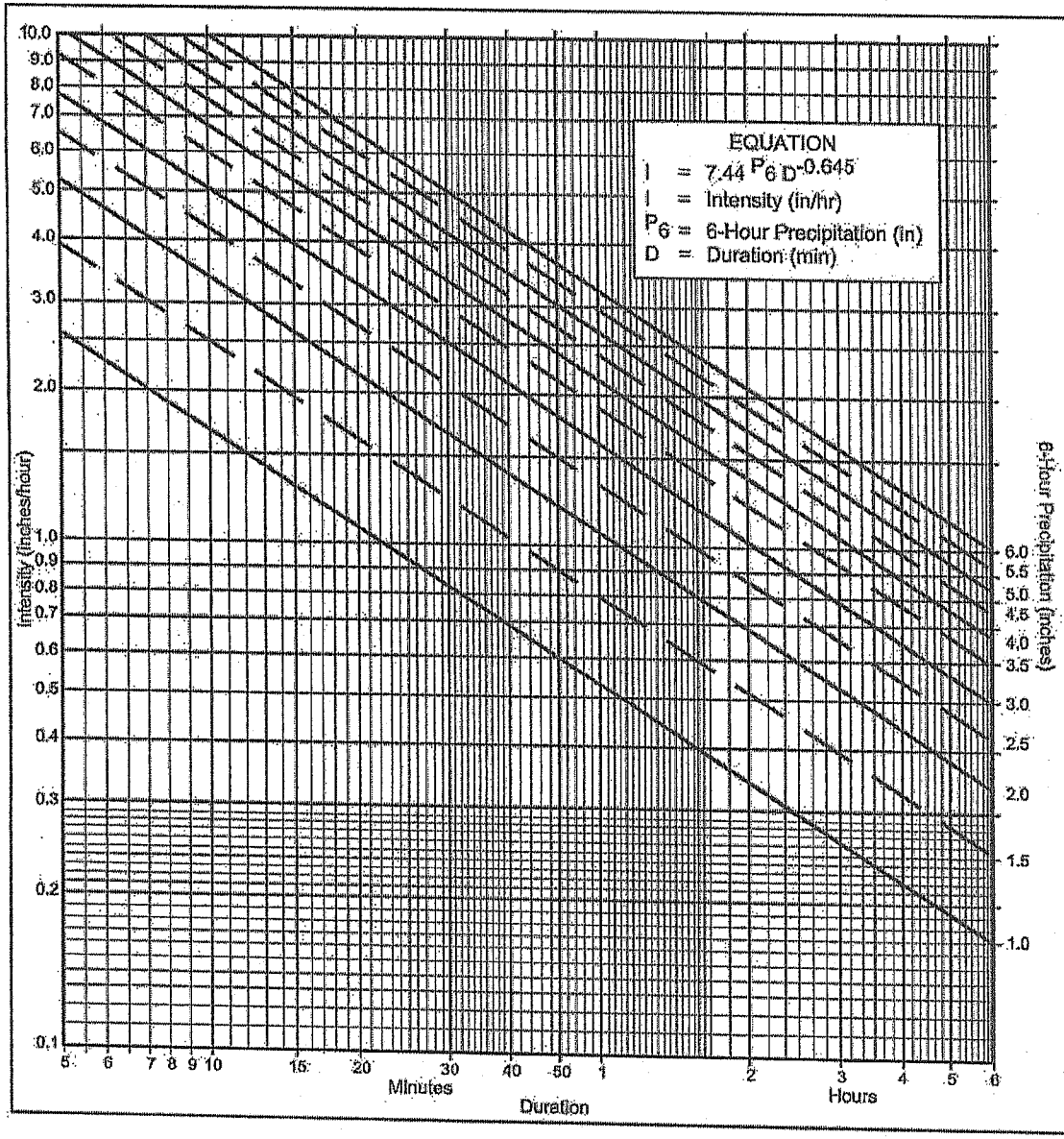
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE 3-3



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted P_6(2) = 3.5 in.

(d) t_x = _____ min.

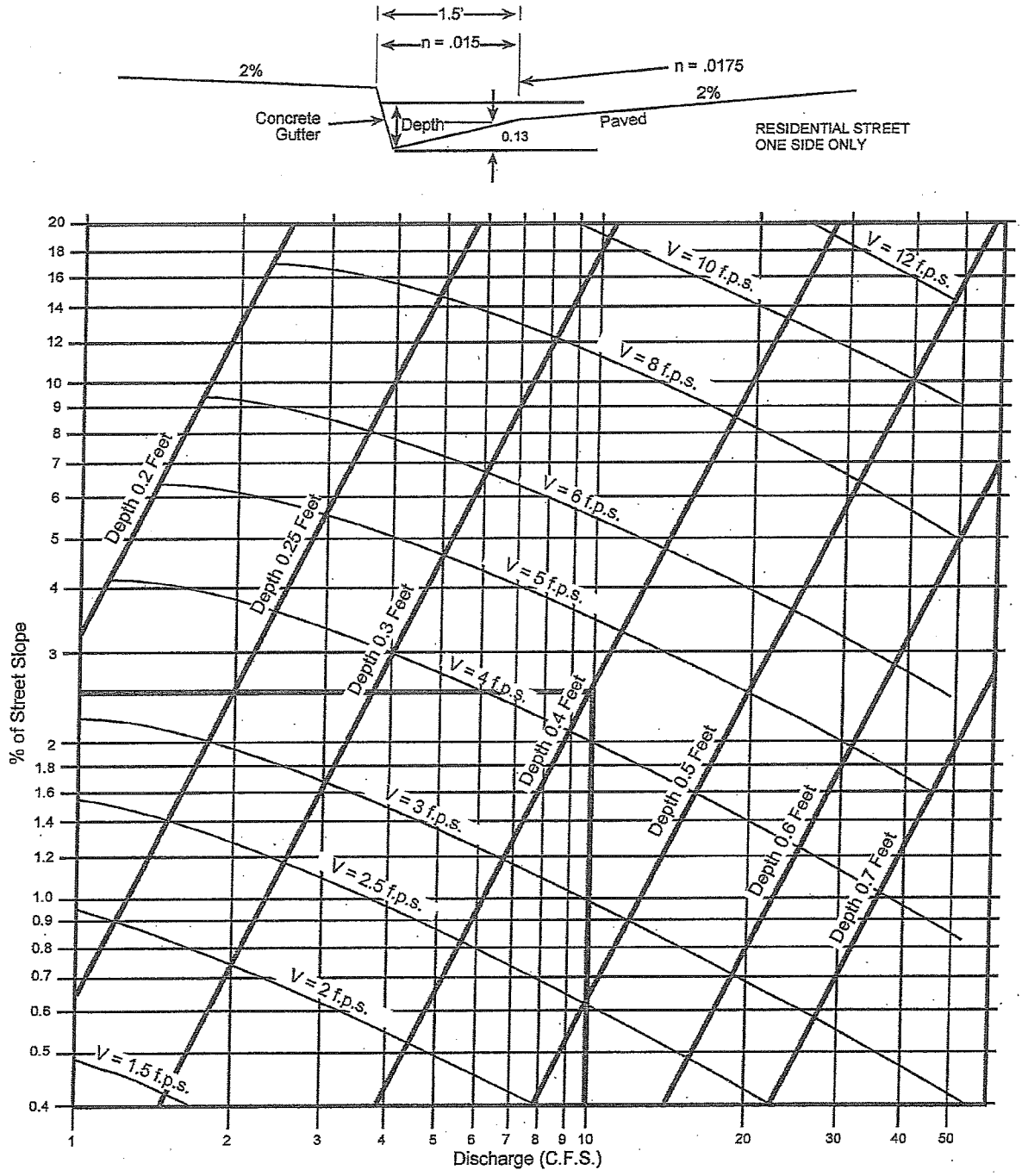
(e) I = _____ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration											
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE
3-1



EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

Gutter and Roadway Discharge - Velocity Chart

FIGURE

3-6

Appendix C
Calculations

INLET CAPACITIES:

Typical Lot: Required Q =0.27 CFS

Weir Flow:

$Q = C_w * P_e * d^{3/2}$, using NDS 8" ground grate:

$Q = 3.0 * 0.89 \text{ ft} * 0.5^{3/2}$

$Q = 0.94$ CFS

Orifice Flow:

$Q = C_o * A_e * (2gd)^{1/2}$

$Q = 0.67 * 0.08 \text{ ft}^2 * (2 * 32.2 * 0.5)^{1/2}$

$Q = 0.30$ CFS

Recreational Area: Required Q = 0.39 CFS

Weir Flow:

$Q = C_w * P_e * d^{3/2}$, using NDS 12" square grate:

$Q = 3.0 * 1.84 \text{ ft} * 0.25^{3/2}$

$Q = 0.69$ CFS

Orifice Flow:

$Q = C_o * A_e * (2gd)^{1/2}$

$Q = 0.67 * 0.42 \text{ ft}^2 * (2 * 32.2 * 0.25)^{1/2}$

$Q = 1.12$ CFS

Village Walk Townhomes

Post-Development
Pipe Flows

			L			Q100							
Drainage Area Designation	*Pipe Designator*	*Pipe Diameter*	*Length of Pipe*	*Slope*	*Mannings "n"*	Design Flow Q100		Minimum Pipe Size	Selected Pipe Size	*Depth*	*Depth / Diameter*	*Flow Velocity*	*Flow Area*
		(Inches)	*(Ft)*	*(%)*		(CFS)		Inches	Inches	*(ft)*	*D/d*	*(fps)*	*(SqFt)*
L-4						0.312							
	L4	6.00	31.0	1.00%	0.013			5	6	0.27	0.53	2.93	0.11
L-3-4						0.615							
	L3	8.00	31.0	1.00%	0.013			7	8	0.34	0.51	3.48	0.18
L-2-4						0.911							
	L2	8.00	31.0	1.00%	0.013			8	8	0.43	0.65	3.80	0.24
L-1-4						1.202							
	L1	8.00	4.0	1.00%	0.013			8	8	0.54	0.81	3.95	0.30
PW-1-L-4						1.269							
	L0	8.00	97.0	1.50%	0.013			8	8	0.48	0.71	4.76	0.27
PW2						0.099							
	L10	4.00	4.0	1.00%	0.013			4	4	0.17	0.51	2.28	0.04
L-8-PW2						0.325							
	L9	6.00	31.0	1.00%	0.013			5	6	0.27	0.55	2.96	0.11
L-7-PW2						0.545							
	L8	6.00	31.0	1.00%	0.013			6	6	0.40	0.80	3.26	0.17
L-6-PW2						0.761							
	L7	8.00	31.0	1.00%	0.013			7	8	0.38	0.58	3.66	0.21
L-5-PW2						0.976							
	L6	8.00	91.0	1.00%	0.013			8	8	0.45	0.68	3.85	0.25
REC-PW2						1.407							
	L5	8.00	4.0	1.50%	0.013			8	8	0.52	0.78	4.82	0.29

TABLE 3

Detention Volume Calculations:

The post-development Input Hydrographs were determined using the procedures outlined in Chapter 6 of the County of San Diego Drainage Design Manual. The hydrographs used are tabulated on the next three pages.

The Stage / Discharge curve was developed using an 18 inch diameter Riser with 5-3 inch circular orifices for the 2-year storm, 4- 3 inch circular orifices for the 10-year storm and a weir for the 100-year storm. The Stage / Discharge curve is plotted on the attached Pond Report.

A trench 14 feet wide, 4 feet deep and 264 feet long, filled with 3 inch minus rock, with a minimum void ratio of 40% is used for the retention basin giving an available volume of 5,900 cubic feet of storage.

The Storage Routing calculations were performed using the Modified Puls method. The required storage volumes were calculated at 2,450 cu ft for the 2-yr storm; 3,777 cu ft for the 10 yr storm, and 4,858 cu ft for the 100 yr storm.

The results of the analysis are tabulated herein.

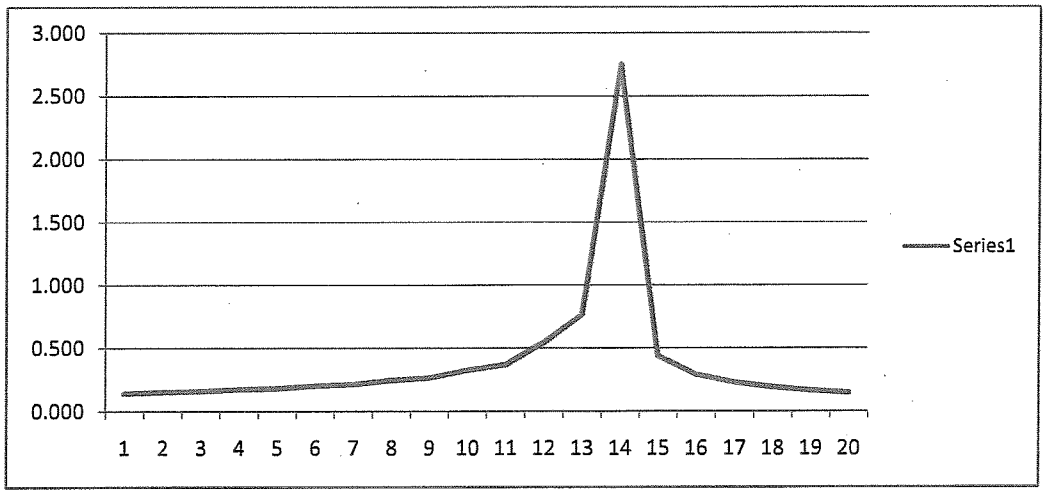
Village Walk Townhomes

DETENTION VOLUME CALCULATIONS

Six Hour Discharge Hydrograph - Post-Development, 2 Year Storm

Six Hour Rainfall	P6=	1.6	in/hr
Area	A=	2.76	Acres
Time of Concentration	Tc=	18	Min
Runoff Coefficient	C=	0.54	
Peak Discharge	Q=	0.0289	CFS
N = (360/Tc)	N=	20	

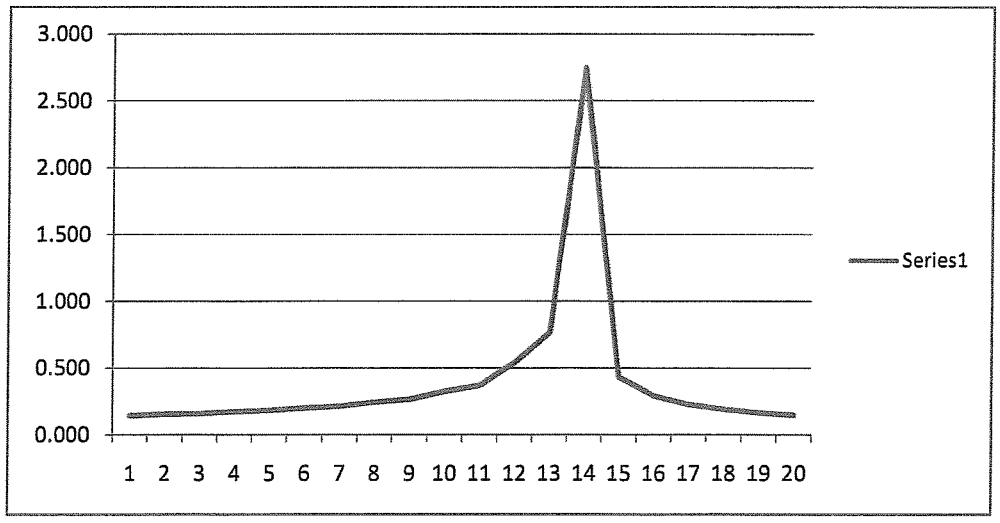
N	$P_{T(N)}$ (inches)	P_N (inches)	Q_N (cfs)	N=20	Q_N (cfs)
1	0.5536	0.5536	2.750	20	0.144
2	0.7080	0.1544	0.767	18	0.154
3	0.8176	0.1096	0.545	17	0.160
4	0.9055	0.0879	0.437	15	0.174
5	0.9802	0.0746	0.371	14	0.182
6	1.0457	0.0655	0.326	12	0.202
7	1.1045	0.0588	0.292	11	0.214
8	1.1581	0.0536	0.266	9	0.246
9	1.2076	0.0495	0.246	8	0.266
10	1.2536	0.0460	0.229	6	0.326
11	1.2968	0.0431	0.214	5	0.371
12	1.3374	0.0407	0.202	3	0.545
13	1.3760	0.0385	0.192	2	0.767
14	1.4127	0.0367	0.182	1	2.750
15	1.4477	0.0350	0.174	4	0.437
16	1.4812	0.0336	0.167	7	0.292
17	1.5135	0.0322	0.160	10	0.229
18	1.5445	0.0310	0.154	13	0.192
19	1.5744	0.0299	0.149	16	0.167
20	1.6034	0.0289	0.144	19	0.149



Six Hour Discharge Hydrograph - Post-Development, 10 Year Storm

Six Hour Rainfall	P6=	2.4	in/hr
Area	A=	2.76	Acres
Time of Concentration	Tc=	18	Min
Runoff Coefficient	C=	0.54	
Peak Discharge	Q=	0.0434	CFS
N = (360/Tc)	N=	20	

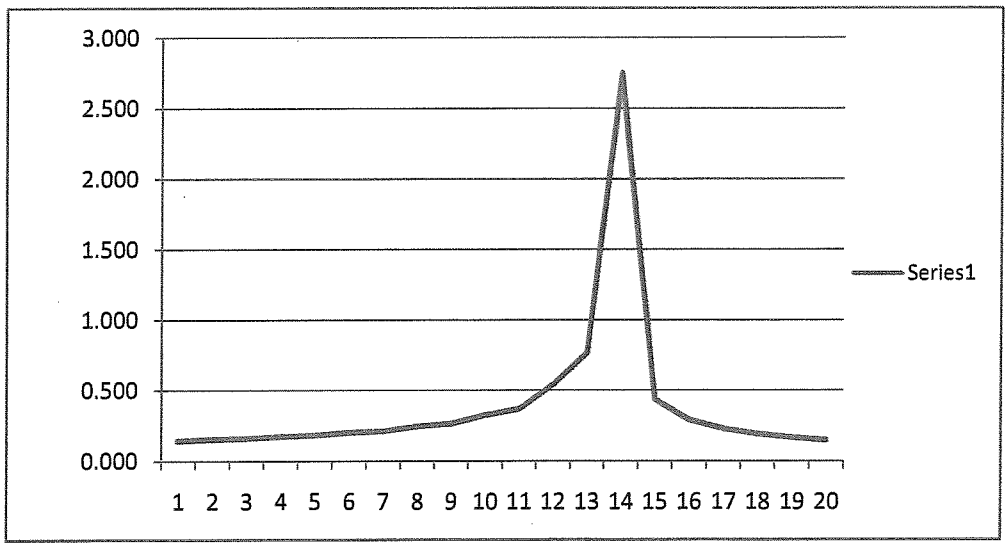
N	$P_{T(N)}$ (inches)	P_N (inches)	Q_N (cfs)	N=20	Q_N (cfs)
1	0.8303	0.8303	4.125	20	0.216
2	1.0620	0.2317	1.151	18	0.231
3	1.2264	0.1644	0.817	17	0.240
4	1.3583	0.1319	0.655	15	0.261
5	1.4702	0.1120	0.556	14	0.273
6	1.5685	0.0983	0.488	12	0.303
7	1.6568	0.0882	0.438	11	0.321
8	1.7372	0.0804	0.400	9	0.369
9	1.8114	0.0742	0.369	8	0.400
10	1.8804	0.0690	0.343	6	0.488
11	1.9451	0.0647	0.321	5	0.556
12	2.0062	0.0610	0.303	3	0.817
13	2.0640	0.0578	0.287	2	1.151
14	2.1190	0.0550	0.273	1	4.125
15	2.1715	0.0525	0.261	4	0.655
16	2.2219	0.0503	0.250	7	0.438
17	2.2702	0.0483	0.240	10	0.343
18	2.3167	0.0465	0.231	13	0.287
19	2.3616	0.0449	0.223	16	0.250
20	2.4050	0.0434	0.216	19	0.223



Six Hour Discharge Hydrograph - Post-Development, 100 Year Storm

Six Hour Rainfall	P6=	3.5	in/hr
Area	A=	2.76	Acres
Time of Concentration	Tc=	18	Min
Runoff Coefficient	C=	0.54	
Peak Discharge	Q=	0.0633	CFS
N = (360/Tc)	N=	20	

N	$P_{T(N)}$ (inches)	P_N (inches)	Q_N (cfs)	N=20	Q_N (cfs)
1	1.2109	1.2109	6.016	20	0.314
2	1.5487	0.3378	1.678	18	0.337
3	1.7885	0.2398	1.191	17	0.350
4	1.9808	0.1923	0.955	15	0.381
5	2.1441	0.1633	0.811	14	0.399
6	2.2875	0.1434	0.712	12	0.442
7	2.4161	0.1287	0.639	11	0.469
8	2.5334	0.1173	0.583	9	0.537
9	2.6416	0.1082	0.537	8	0.583
10	2.7423	0.1007	0.500	6	0.712
11	2.8367	0.0944	0.469	5	0.811
12	2.9256	0.0890	0.442	3	1.191
13	3.0100	0.0843	0.419	2	1.678
14	3.0902	0.0802	0.399	1	6.016
15	3.1668	0.0766	0.381	4	0.955
16	3.2402	0.0734	0.365	7	0.639
17	3.3107	0.0705	0.350	10	0.500
18	3.3786	0.0679	0.337	13	0.419
19	3.4440	0.0655	0.325	16	0.365
20	3.5073	0.0633	0.314	19	0.325



Hydraflow Table of Contents

VWDetention.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Jan 20, 2010

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	Rational	------	-------	1.631	-------	-------	2.446	-------	-------	3.568	Pre-Development
2	Manual	------	-------	2.750	-------	-------	4.130	-------	-------	6.020	County of San Diego
3	Reservoir	2	-------	1.187	-------	-------	1.987	-------	-------	3.574	Pond Rounting

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Rational	1.631	1	22	2,153	------	------	------	Pre-Development
2	Manual	2.750	18	252	8,575	------	------	------	County of San Diego
3	Reservoir	1.187	18	270	8,382	2	1411.80	2,450	Pond Rounting

Hydrograph Report

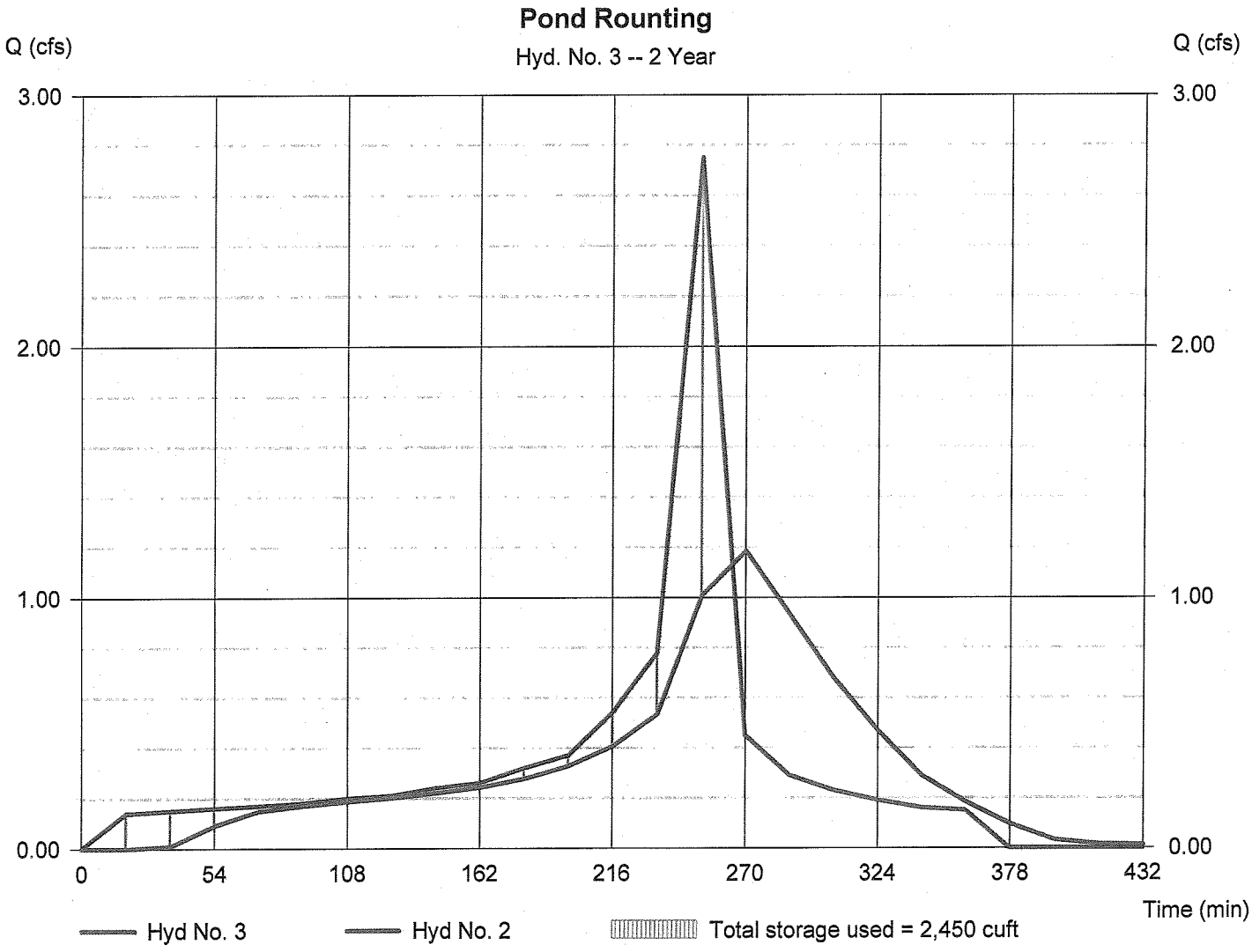
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Jan 20, 2010

Hyd. No. 3

Pond Rounting

Hydrograph type	= Reservoir	Peak discharge	= 1.187 cfs
Storm frequency	= 2 yrs	Time to peak	= 270 min
Time interval	= 18 min	Hyd. volume	= 8,382 cuft
Inflow hyd. No.	= 2 - County of San Diego	Max. Elevation	= 1411.80 ft
Reservoir name	= Trench	Max. Storage	= 2,450 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Rational	2.446	1	22	3,228	------	------	------	Pre-Development
2	Manual	4.130	18	252	12,863	------	------	------	County of San Diego
3	Reservoir	1.987	18	270	12,669	2	1412.83	3,777	Pond Rounting

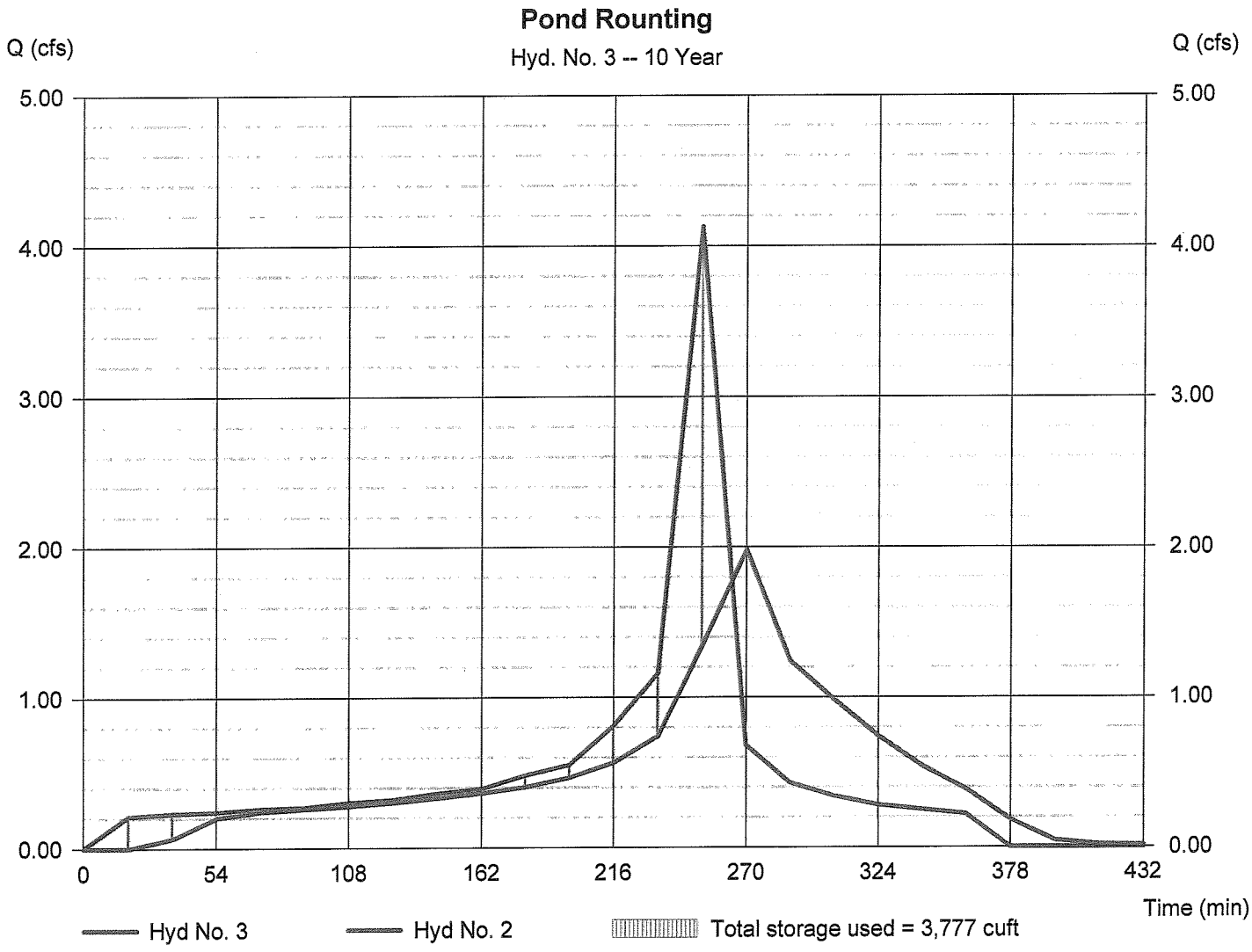
Hydrograph Report

Hyd. No. 3

Pond Rounting

Hydrograph type	= Reservoir	Peak discharge	= 1.987 cfs
Storm frequency	= 10 yrs	Time to peak	= 270 min
Time interval	= 18 min	Hyd. volume	= 12,669 cuft
Inflow hyd. No.	= 2 - County of San Diego	Max. Elevation	= 1412.83 ft
Reservoir name	= Trench	Max. Storage	= 3,777 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph description
1	Rational	3.568	1	22	4,710	------	------	------	Pre-Development
2	Manual	6.020	18	252	18,673	------	------	------	County of San Diego
3	Reservoir	3.574	18	270	18,479	2	1413.96	4,858	Pond Rounting

Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066 Wednesday, Jan 20, 2010

Hyd. No. 3

Pond Rounting

Hydrograph type	= Reservoir	Peak discharge	= 3.574 cfs
Storm frequency	= 100 yrs	Time to peak	= 270 min
Time interval	= 18 min	Hyd. volume	= 18,479 cuft
Inflow hyd. No.	= 2 - County of San Diego	Max. Elevation	= 1413.96 ft
Reservoir name	= Trench	Max. Storage	= 4,858 cuft

Storage Indication method used.